Power Supply Design

2010-01-08 15:01:53 by Nick

One of the fundamental components that every THAT module will need is a Power-over-ethernet (PoE) power supply. Although not required, it is likely that most THAT modules will make use of identical or very similar power supplies.

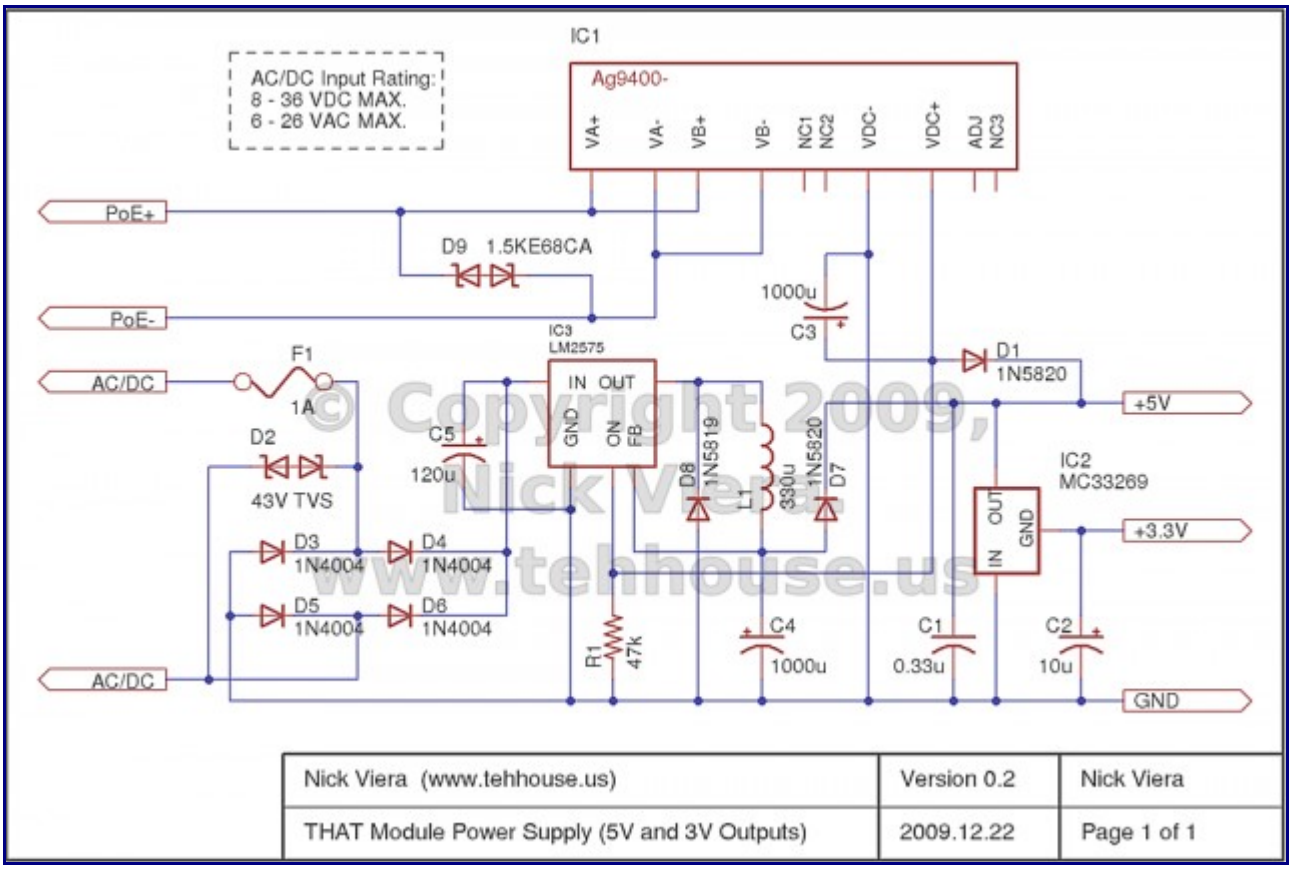
With this in mind, I began the design process for a power supply “sub-module” which I plan to use as part of my Digital Thermostat Module and which could be a design used for the other modules.
The power supply module has two input sources (PoE and external AC/DC input) and two outputs (5 and 3.3 Volts DC).The 5VDC source is used to power the microcontroller, LCD module, and most peripherals. The 3.3VDC source is necessary for powering the ethernet controller IC and its peripherals, as they do not support 5VDC operation. The 3.3VDC was not used exclusively to power the entire system due to the following reasons:

- The microcontroller cannot operate at full speed unless powered from a 5VDC source.
- Most of the LCD modules which are good candidates for this project are 5VDC only.
- Using 3.3V peripherals would draw more current, resulting in larger circuit board traces.
- Power losses in the regulators would increase.

To handle the PoE functionality, as per the IEEE 802.3af standard, I have selected a PoE module from the manufacturer Silver. The model I will be using is the Silver Ag9400-S PoE power supply module. This modules in hardware handles the “handshake” procedure for identifying and obtaining power from a PoE powering device and outputs regulated 5 Volts DC.

To generate regulated 5 Volts DC from the auxilary AC/DC input, I have selected the LM2575 IC. This device utilizes a couple external components to create a high-efficiency buck converter, which is one type of switch-mode power supply (SMPS). From either 5 Volt DC source listed above, I then chose a MC33269 IC, which is a linear regulator, to provide regulated 3.3 Volts DC.

The preliminary schematic for the power supply (version 0.2) is shown below, along with a suggested parts list to build the supply.



-- Parts List --

Part ID	Type	Attr.	Temperature Min.	Temperature Max	Package	Digikey Part	Manufacturer Part	Unit Price x1	Unit Price x25	Unit Price x100	Qty	Extended Price x1	Extended Price x25	Extended Price x100
C2	Capacitor	10uF, 25V, electro.	-40	85	Round, 4mm	P813-ND	ECE-A1EKA100	0.14	0.09	0.06	1	0.14	0.09	0.06
IC1	IC	PoE supply, Isolated	-20	70	Rectangle	(Silvertel)	Ag9405-2BR	8.08	8.08	8.08	1	8.08	8.08	8.08
R1	Resistor	47k, 5%, carbon	-55	155	Axial	CF1/4 47KJRCT-ND	CF 1/4 47K 5% R	0.08	0.05	0.02	1	0.08	0.05	0.02
R2	Resistor	8.2k, 5%, carbon	-55	155	Axial	CF1/4 8.2KJRCT-ND	CF 1/4 8.2K 5% R	0.08	0.05	0.02	1	0.08	0.05	0.02
D1,7,8	Diode	60V, 2A, Schottky	-65	125	DO-41	SR206-TPCT-ND	SR206-TP	0.43	0.30	0.20	3	1.29	0.91	0.59
D1,7	Diode	20V, 3A, Schottky	-55	125	DO-201AD	1N5820-TPMSCT-ND	1N5820-TP	0.42	0.32	0.23	0	0.00	0.00	0.00
C5	Capacitor	120uF, 50V, electro.	-55	105	10mm, 5 grid	493-1901-ND	UPW1H121MPD6	0.41	0.29	0.19	1	0.41	0.29	0.19
C1	Capacitor	0.33uF, 50V, film	-40	105	5mm grid	P4669-ND	ECQ-V1H334JL	0.15	0.15	0.13	1	0.15	0.15	0.13
D3-6	Diode	1N4004,	-55	175	DO-41	1N4004FSCT-ND	1N4004	0.09	0.07	0.05	4	0.36	0.26	0.19
	Inductor	330uH, 1.15A			SMD 12.5mm	SRR1260-331KCT-ND	SRR1260-331K	1.09	0.93	0.85	1	1.09	0.93	0.85
IC3	IC	Vreg, 4-40V, 1A, 5V	-40	125	TO-220-5	LM2575T-5GOS-ND	LM2575T-5G	2.47	2.14	1.89	1	2.47	2.14	1.89
IC4	IC	Vreg, 3.3V, 800mA	-40	125	TO-220	MC33269T-3.3GOS-ND	MC33269T-3.3G	1.01	0.90	0.78	1	1.01	0.90	0.78
D9	Diode	TVS, 68V, bi, 1500W	-55	175	DO-201AD	1.5KE68CALFCT-ND	1.5KE68CA	0.65	0.60	0.50	1	0.65	0.60	0.50
D2	Diode	TVS, 43V, bi, 600W	-55	175	DO-15	P6KE43CALFCT-ND	P6KE43CA	0.38	0.35	0.29	1	0.38	0.35	0.29
F1	Fuse	500mA, Fast blow			5x20mm	486-1233-ND	0034.1513	0.23	0.18	0.15	1	0.23	0.18	0.15
F1	Fuse	Plastic, Black, Hor.			5x20mm	486-1259-ND	0031.8211	0.53	0.44	0.36	1	0.53	0.44	0.36
	Capacitor	680uF, 10V, electro.	-40	105	8x15, 3.5 grid	P12365-ND	EEU-FM1A681L	0.37	0.27	0.19	2	0.74	0.54	0.39
Parts List – Power Supply 0.3 – Copyright Nick Viera – 2009.12.28										**Total:**	22	**17.69**	**15.96**	**14.50**